

## FUZZY ANALYSIS OF REGIONAL DEVELOPMENT

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In this paper region is considered as the territory limited by the existing administrative-territorial segmentation because only administrative segmentation has authorities and opportunities to manage of socio-economic development. The term of “the socio-economic development” includes an indication of the simultaneous control of several areas: economic, financial, demographic, social, ecological. The complex of these fields leads to the effective socio-economic development named sustainable. But each of these fields is characterized by set of criteria. As a result the number of analyzed parameters ups to several dozen. The regional governance is interesting in evaluation of each area and of the whole system development. More over the estimation should be made in dynamic and in comparison with other counties. For this purpose the system of indexes should base on open source data.

This paper presents the fuzzy clustering application for object evaluation. The methodology of research this analysis was applied to experimental research at Belarusian regions. For experimental check of our methodology we apply it to the evaluation of socio-economic development of Grodno’s local region (Belarus). We used the data for 28 indexes value of 17 Grodno’s local regions and city Grodno in 2008-2014. All of them were led to the comparable form. It was interesting to estimate the correlation between these indexes. The following result was received by correlation analysis: there is a strong relationship between the value of the population (one of the main demographic indicators) and the majority of economic indicators (regional budget (0.95), turnover (0.93), retail trade (0.97), paid services (0.97), the volume of industrial production (0.9), the number of employed in the economy (0.99)). It mean that population (or the number of employed in the economy) is the determining factor for economic growth in Belarus regions. The absence of indexes for evaluating information and communication technologies at local regional level doesn’t let us to characterize local economy as post-industrial.

The methodology provides an opportunity of using an integral criterion for assessment and building a rating of regions by this criterion. The strong correlations between indexes allow to use the principal components analysis. First principal component (determined by following indexes: regional budget, investments, retail trade, paid services, receivables and payables, employment value, industrial production, goods turnover and value of constructions) retains 51.99% of the variance. It reaffirms that Belarusian economy is not at the post-industrial step yet. The second principal component retains 13.3% of the variance. This component is mostly determined by rural factors (livestock capita and productivity of yield).

For the national economic development integral criterion is gross domestic product (GDP). The analog of this criterion on regional level is gross regional product (GRP). But it’s determined only by value-added approach and in Belarus only for high Regional County. It’s possible to adopt the expenditure approach to the local re-

gions and calculate analog of *GRP* at local level. In this case, the *GRP* will be formed as sum of household expenditure (*C*), investment (*I*), government expenditure (*G*) and net exports (*Xn*). The formula of calculating is:  $GRP = C + G + I + Xn$ .

This method allows receiving the integral result of economic development. Moreover all factors (except export) which assumed in *GRP* were included in first principal component. So we used the most influential factors in this method.

To test this method of calculating *GRP* we compare results of official data of *GRP* and calculated by this method at high level of regional economy. We received that the degrees of each region in total *GRP* by official and calculated values have not a significant discrepancy between two samples. So we can use this methodology for evaluating the share of each local region in the economic reward of high region. We should include in integral criterion that regions have different size. For this aim we calculated *GRP* per Capita by dividing the value of *GRP* to the average population.

To evaluate the regional economic growth can be used fuzzy clusters analysis. In this research we make 4 clusters: low, medium, high and top of socio-economic development. It's interesting to use fuzzy clusters because it's impossible instantaneous transition from one group to another. The membership function shows the degree of membership of each local region to each group.

The research confirms that there is a high degree of differentiation of Grodno's local regions development. The membership functions of clusters and corresponding value of *GRP* are presented on fig.1. The results of regions attitude to fuzzy clusters are presented on the map of region at fig.2. The darker color means the higher the level of economic development of region. Some regions refer to two clusters with different degree simultaneously. It is reflected as double color.

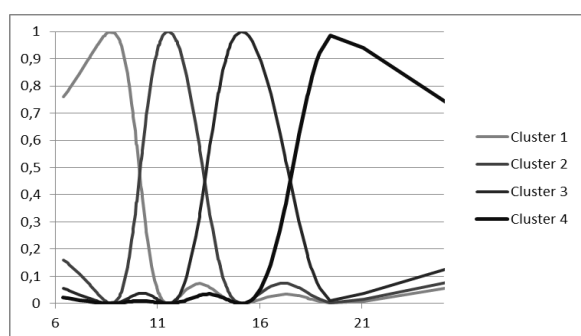


Fig.1 - Membership functions and *GRP*

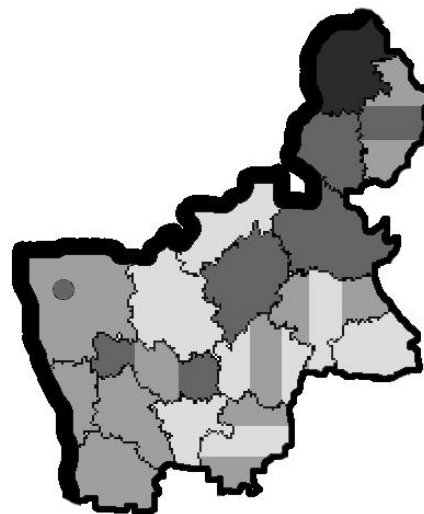


Fig.2 - Regions attitude to fuzzy cluster in 2014

In the case of multi-dimensional fuzzy clusters the benchmark data were ranked by population. Calculations shows that there's high inhomogeneity in regional socio-economic development.

The results of this analysis are useful for place marketing strategy development.